APPENDIX F
SEDIMENT LOADING ANALYSIS

This appendix summarizes the methods used to determine the sediment load estimates from hillslopes, stream banks and roads in the Lower Blackfoot-Nevada Creek planning area. Hillslope erosion loading was estimated using the Soil Water Assessment Tool (SWAT) model to obtain an initial estimate of loading by listed segment. A description of the SWAT model, its setup, calibration, and validation for use in the Blackfoot River watershed is contained in **Appendix D**.

Stream bank erosion was estimated for sediment impaired stream segments using field data collected from selected assessment sites within each segment. The field assessment method was a modification of the Bank Erosion Hazard Index (BEHI) method of Rosgen (2000). The details of the methodology and procedures for extrapolation from surveyed sites to non-surveyed stream reaches are described in **Appendix E**.

Sediment loading from unpaved roads was estimated by extrapolating annual means (tons/yr/crossing), developed from field survey results for the Middle Blackfoot TPA, to similar crossings in the Lower Blackfoot. Annual loading from road culvert failure also extrapolates per crossing means, used in the Middle Blackfoot, to Lower Blackfoot crossings.

Hillslope Erosion Loading Estimates and Adjustments

Sediment loading from hillslope erosion was estimated through use of the SWAT model. Model output included the number of tons of hillslope sediment delivered annually from each of 65 subbasins in the Blackfoot River watershed. Due to large differences between subbasin land surface slope and stream channel slope, the model simulated hillslope erosion rates that were much higher than channel transport capacities could accommodate. This sediment "bottle-necking" effect is due to the model's convention of assigning a single land surface slope value per subbasin. In a mountain valley setting land surface slope may be an order of magnitude greater than the stream channel slope. The steep, uniform slope configuration in the model exaggerates sediment loading to the channel. To compensate, SWAT estimates were adjusted downward to reflect the fraction of the subbasin area that more realistically delivers sediment to the channel network.

The surface erosion component of SWAT uses the modified universal soil loss equation (MUSLE) to quantify sediment transported by overland flow as sheet erosion. Overland flow is water moving down slope as an irregular sheet prior to concentration in defined channels. Though estimates vary, the slope length over which overland flow occurs is usually less than 400 feet (McCuen 1998). A distance criterion of 350 feet and a slope criterion of greater than 3 percent were used in this analysis to obtain the fraction of each subbasin area likely to contribute sediment through sheet erosion to channels. GIS tools were used to define a 350-foot buffer and classify slopes greater than 3 percent on sediment impaired streams and their tributaries. The fraction, calculated by dividing the buffer area by the total subbasin area was used to adjust the SWAT subbasin sediment yields downward. These values are labeled as adjusted sheetflow area yields and given by listed stream segment in **Table F-1**. These adjusted yields were next apportioned into naturally occurring and controllable components.

The naturally occurring load was assumed to be that delivered with adequate vegetative filter conditions in place on contributing land cover types. A sediment reduction efficiency of 75 percent was assumed to represent naturally occurring loading conditions for this analysis. This value better reflects those reported in the general literature (Castelle and Johnson 2000) and is closer to results reported for Montana settings (Hook 2003) while allowing for some hillslope loading from developed land. With 75 percent removal, 25 percent of the adjusted hillslope sediment yield is the assumed naturally occurring load representing the annual maximum loads from hillslope erosion in **Table F-1**. The remaining 75 percent of the adjusted hillslope load is assumed to be controllable by land management activities.

The initial SWAT hillslope sediment yields and the adjusted sheetflow area loads for each stream segment in **Table F-1** are displayed discretely. The discrete listing illustrates the degree of yield adjustment according to the fraction of total sediment contributing area in the subbasin that is within the sheetflow area. After the sheetflow area adjustment, values for sheetflow area yield, naturally occurring loads and controllable loads are added cumulatively in the table from the headwaters to the downstream outlets of listed segments. The cumulative naturally occurring load is the portion of the cumulative sheetflow area yield that is delivered from background hillslope erosion processes and from erosion processes on developed land with assumed application of all reasonable land, soil, and water conservation practices.

Using the Keno Creek values as an example, the SWAT model estimated load of 4 tons/yr is reduced by the sheetflow area fractions of 0.26 to one ton/yr. Since Keno Creek is a headwaters segment, the cumulative annual is also one ton/yr. Per the discussion of naturally occurring hillslope erosion above, 0.25 tons/yr (rounded to 0.3) and 0.75 tons/yr (rounded to 0.8) become the annual naturally occurring and controllable fractions of current loading.

Table F-1. Hillslope Sediment Yield Adjustment and Partitioning into Naturally Occurring and Human-Caused Components

Stream Name	Initial SWAT Sediment Load Estimate (tons/yr)	Sheetflow Source Area Fraction	Adjusted Sheetflow Area Load (tons/yr)	Cumulative Sheetflow Area Load (tons/yr)	Cumulative Naturally Occurring Load (tons/yr)	Cumulative Controllable Load (tons/yr)
East Ashby Creek	32.0	0.27	9.0	9.0	2.0	7.0
West Ashby Creek	143.0	0.38	55.0	55.0	14.0	41.0
Belmont Creek	1727.0	0.30	510.0	510.0	128.0	383.0
Keno Creek	4.0	0.26	1.0	1.0	0.3	0.7
Upper Elk Creek	279.0	0.35	95.0	96.0	24.0	72.0
Lower Elk Creek	44.0	0.32	14.0	110.0	28.0	82.0
Washoe Creek	8.0	0.25	2.0	2.0	1.0	1.0
Camas Creek	542.0	0.26	79.0	143.0	36.0	107.0
Union Creek	822.0	0.32	241.0	387.0	97.0	290.0
Totals	3,601		1,006	1,006	253.3	753.0

With the adjustments, the total SWAT subbasin yield of 3,601 tons/yr (**Table 5-17**) for the Lower Blackfoot planning area was reduced by 72 percent to 1,006 tons/yr. The low discrete values for adjusted sheetflow yield for Keno and Washoe creeks reflect the low hillslope yields estimated by the SWAT model in these subbasins.

Existing ground cover conditions within the sheet erosion source areas were assumed to have some sediment filtering capacity. Ground cover condition categories of "sparse," "moderate," or "dense" were assigned as part of the 2006 base parameter assessment. With these ground cover conditions as guidance, 2005 aerial and ground photography were interpreted to estimate an existing filtering efficiency value for each stream. These values range from 0.50 to 0.9 and represent coarse estimates of the effect of current vegetation on sediment removal. When multiplied by the values for controllable load from each listed segment, the product is the controllable load reductions needed to reflect naturally occurring conditions on developed land. Since the sediment removal efficiency figures describe sediment filtering conditions adjacent to each listed stream segment, the reductions are applied to segment-specific loads in **Table F-2**. Reductions are not estimated for streams determined to be fully supporting.

Table F-2. Controllable Loads, Sediment Removal Efficiency and Hillslope Load Reductions for Listed Stream Segments in the Lower Blackfoot- Planning Area

Stream Name	Controllable Load (tons/yr)	Existing Sediment Removal Efficiency	Needed Reductions to Controllable Load (tons/yr)
East Ashby Creek	7.0	0.50	3.5
West Ashby Creek	41.0	0.70	12.3
Belmont Creek	383.0	0.87	49.8
Keno Creek	1.0	0.68	0.2
Upper Elk Creek	71.0	0.70	21.3
Lower Elk Creek	11.0	0.60	4.4
Washoe Creek	2.0	0.80	0.4
Camas Creek	59.0	0.55	26.6
Union Creek	181.0	0.73	48.9
Totals	756		167

Considered cumulatively from upstream to downstream, existing sediment removal capacity reduces the controllable load by 78 percent from 756 to 167 tons per year.

Stream Bank Erosion Loading

The base parameter and stream bank erosion inventory project undertaken in 2006 included direct measurement of sediment from eroding banks on representative reaches of 303(d) Listed streams. **Section 5** of this document and **Appendix C** describe the assessment methodology and results. The Bank Erosion Hazard Index method of Rosgen (2000) was used to obtain measured values for reach specific stream bank erosion rates. Measurements of total bank erosion were partitioned into controllable and background components by assuming a degree of improvement in selected stream bank dimensional and condition parameters that would occur in the absence human influence. The difference between the measured rate and the rate reflecting no human influence defined the human-caused load. **Table F-3** contains an accounting of the total stream bank loads, human-caused loads, and background loading for assessed reaches of listed segments in the Lower Blackfoot TPA. The total, human-caused, and background contributions from listed stream segments are entered cumulatively in the last three columns of the table.

The estimated stream bank sediment load of 1,326 tons/yr from human-caused sources in the Lower Blackfoot planning areas is 30 percent of the total annual stream bank load of 4,456 tons/yr.

Table F-3. Lower Blackfoot Planning Area Stream Bank Sediment Load Estimates by Assessment Reach and 303 (d) Listed Stream Segment

Stream Name	Reach Code	Reach Load (Tons/Yr)	Human Caused Fraction	Human Caused Reach Load (Tons/ Yr)	Background Reach Load (Tons/Yr)	Total Segment Load (Tons/ Yr)	Cumulative Total Segment Load (tons/yr)	Cumulative Background Segment Load (tons/yr)	Cumulative Human Caused Segment Load (tons/yr)
Keno Creek	Keno1	0.2	26%	0.1	0.2	4.4	4.4	3.2	1.2
	Keno2	2.6	26%	0.7	2.0				
	Keno3	0.8	26%	0.2	0.6				
	Keno4	0.7	36%	0.3	0.4				
Elk Creek. Upper	Elk1	0.3	26%	0.1	0.2	91.6	95.9	62.5	33.4
	Elk2	3.9	26%	1.0	2.9				
	Elk3	31.4	26%	8.2	23.2				
	Elk4	15.2	41%	6.3	9.0				
	Elk5	10.4	41%	4.3	6.1				
	Elk6	30.3	41%	12.4	17.9				
Elk Creek. Lower	Elk7	202.7	33%	66.9	135.8	449.9	545.9	372.7	173.2
	Elk8	99.3	26%	25.8	73.5				
	Elk9	62.8	37%	23.2	39.5				
	Elk10	85.2	28%	23.9	61.3				
Belmont Creek	Bel1	1.0	38%	0.4	0.6	83.0	83.0	59.9	23.1
	Bel2	11.7	38%	4.5	7.3				
	Bel3	37.6	26%	9.8	27.8				
	Bel4	32.7	26%	8.5	24.2				
Washoe Creek	Washoe 1	0.4	31%	0.1	0.3	115.3	115.3	79.6	35.7
	Washoe 2	80.4	31%	24.9	55.5				
	Washoe 3	24.3	31%	7.5	16.8				
	Washoe	10.1	31%	3.1	7.0				

Table F-3. Lower Blackfoot Planning Area Stream Bank Sediment Load Estimates by Assessment Reach and 303 (d) Listed Stream Segment

Stream Name	Reach Code	Reach Load (Tons/Yr)	Human Caused Fraction	Human Caused Reach Load (Tons/ Yr)	Background Reach Load (Tons/Yr)	Total Segment Load (Tons/ Yr)	Cumulative Total Segment Load (tons/yr)	Cumulative Background Segment Load (tons/yr)	Cumulative Human Caused Segment Load (tons/yr)
	4								
Ashby Creek, East	EAshb1	0.4	31%	0.1	0.2	6.5	6.5	4.1	2.4
	EAshb2	2.7	31%	0.8	1.9				
	EAshb3	3.4	41%	1.4	2.0				
Ashby Creek, West	WAshb 1	0.6	29%	0.2	0.4	15.7	15.7	11.1	4.5
	WAshb 2	1.1	29%	0.3	0.8				
	WAshb 3	14.0	29%	4.1	9.9				
Camas Creek	Cam1	0.5	26%	0.1	0.4	468.0	490.2	348.8	141.4
	Cam2	219.7	26%	57.1	162.6				
	Cam3	64.8	26%	16.8	47.9				
	Cam4	95.1	33%	31.4	63.7				
	Cam5	22.6	33%	7.5	15.1				
	Cam6	47.1	33%	15.6	31.6				
	Cam7	18.3	33%	6.0	12.3				

Table F-3. Lower Blackfoot Planning Area Stream Bank Sediment Load Estimates by Assessment Reach and 303 (d) Listed Stream Segment

Stream Name	Reach Code	Reach Load (Tons/Yr)	Human Caused Fraction	Human Caused Reach Load (Tons/ Yr)	Background Reach Load (Tons/Yr)	Total Segment Load (Tons/ Yr)	Cumulative Total Segment Load (tons/yr)	Cumulative Background Segment Load (tons/yr)	Cumulative Human Caused Segment Load (tons/yr)
Union Creek	Union1	196.9	32%	63.0	133.9	3221.3	3826.8	2697.1	1129.7
	Union2	26.3	32%	8.4	17.9				
	Union3	26.1	26%	6.8	19.3				
	Union4	8.0	26%	2.1	6.0				
	Union5	235.3	26%	61.2	174.1				
	Union6	145.1	26%	37.7	107.3				
	Union7	19.1	26%	5.0	14.1				
	Union8	24.7	26%	6.4	18.3				
	Union9	86.8	30%	26.0	60.7				
	Union10	1520.7	30%	456.2	1064.5				
	Union11	931.1	30%	279.3	651.7				
	Union12	1.2	30%	0.4	0.8				
TPA Totals		4455.7		1326.0	3129.7	4455.7	4455.7	3129.7	1326.0

The passive restoration analysis divides the stream bank load into a human-caused component and a background component. Applying all reasonable land, soil and water conservation practices to developed land does not necessarily result in background sediment loading devoid of human influence. Therefore, a load reduction factor was developed for this analysis to reflect conservation practice effectiveness and the actual extent of stream banks affected by human land uses in each assessment reach. This achievable reduction multiplier is the product of two factors:

1. The percentage of stream bank length having a discernable land use,
2. A literature based coefficient of 0.8 representing the actual effectiveness of conservation practices in reducing sediment loading.

The multipliers range from 0 percent to 80 percent, with the lower percentages applying to more remote headwaters reaches having few human impacts and inherently stable channel types. Larger deductions are more common on lower reaches where human influence is more extensive. **Table F-4** lists the land use extent and the achievable reduction to the human caused component of stream bank erosion for each assessment reach. The right-most column in the table contains total loading figures for the corresponding stream segment.

Table F-4. Lower Blackfoot Stream Bank Land Use Extent and Erosion Load Apportionment into Human Caused Loading, Background Loading and Achievable Reductions to Human Caused Loading

Listed Segment Name	Assessment Reach Name	Human Caused Load (tons/yr)	Stream Bank Land Use Extent (Percent)	Achievable Reduction in Human Caused Load (Percent)	Achievable Reduction in Human Caused Load (tons/yr)	Achievable Reduction in Human Caused Segment Load (tons/yr)
Keno Creek	Keno1	0.1	10.0%	8%	0.0	0.6
	Keno2	0.7	60.0%	48%	0.3	
	Keno3	0.2	60.0%	48%	0.1	
	Keno4	0.3	70.0%	56%	0.1	
Upper Elk Creek	Elk1	0.1	10.0%	0%	0.0	13.3
	Elk2	1.0	45.0%	36%	0.4	
	Elk3	8.2	50.0%	40%	3.3	
	Elk4	6.3	85.0%	68%	4.3	
	Elk5	4.3	40.0%	32%	1.4	
	Elk6	12.4	41.2%	33%	4.1	
Lower Elk Creek	Elk7	66.9	84.6%	68%	45.3	93.7
	Elk8	25.8	99.8%	80%	20.6	
	Elk9	23.2	99.6%	80%	18.5	
	Elk10	23.9	48.9%	39%	9.3	
Belmont Creek	Bel1	0.4	85.0%	68%	0.3	13.6
	Bel2	4.5	85.0%	68%	3.0	
	Bel3	9.8	80.1%	64%	6.3	
	Bel4	8.5	60.0%	48%	4.1	
Washoe Creek	Washoe1	0.1	60.0%	48%	0.1	10.8
	Washoe2	24.9	22.2%	18%	4.4	
	Washoe3	7.5	67.5%	54%	4.1	
	Washoe4	3.1	88.5%	71%	2.2	

Table F-4. Lower Blackfoot Stream Bank Land Use Extent and Erosion Load Apportionment into Human Caused Loading, Background Loading and Achievable Reductions to Human Caused Loading

Listed Segment Name	Assessment Reach Name	Human Caused Load (tons/yr)	Stream Bank Land Use Extent (Percent)	Achievable Reduction in Human Caused Load (Percent)	Achievable Reduction in Human Caused Load (tons/yr)	Achievable Reduction in Human Caused Segment Load (tons/yr)
East Ashby	EAshb1	0.1	5.0%	4%	0.0	1.1
	EAshb2	0.8	27.2%	22%	0.2	
	EAshb3	1.4	84.3%	67%	1.0	
West Ashby	WAshb1	0.2	62.7%	50%	0.1	2.6
	WAshb2	0.3	53.7%	43%	0.1	
	WAshb3	4.1	72.9%	58%	2.4	
Camas Creek	Cam1	0.1	34.2%	27%	0.0	87.1
	Cam2	57.1	63.4%	51%	29.0	
	Cam3	16.8	81.2%	65%	10.9	
	Cam4	31.4	97.8%	78%	24.6	
	Cam5	7.5	95.4%	76%	5.7	
	Cam6	15.6	97.3%	78%	12.1	
	Cam7	6.0	99.5%	80%	4.8	

Table F-4. Lower Blackfoot Stream Bank Land Use Extent and Erosion Load Apportionment into Human Caused Loading, Background Loading and Achievable Reductions to Human Caused Loading

Listed Segment Name	Assessment Reach Name	Human Caused Load (tons/yr)	Stream Bank Land Use Extent (Percent)	Achievable Reduction in Human Caused Load (Percent)	Achievable Reduction in Human Caused Load (tons/yr)	Achievable Reduction in Human Caused Segment Load (tons/yr)
Union Creek	Union1	63.0	63.3%	51%	31.9	677.8
	Union2	8.4	80.7%	65%	5.4	
	Union3	6.8	68.6%	55%	3.7	
	Union4	2.1	92.9%	74%	1.6	
	Union5	61.2	83.0%	66%	40.6	
	Union6	37.7	59.6%	48%	18.0	
	Union7	5.0	74.5%	60%	3.0	
	Union8	6.4	92.7%	74%	4.8	
	Union9	26.0	93.9%	75%	19.6	
	Union10	456.2	94.9%	76%	346.5	
	Union11	279.3	90.7%	73%	202.6	
	Union12	0.4	74.0%	59%	0.2	
		1,327.5			901.2	901.2

Sediment Loading From Culvert Failure

The estimation of sediment from roadways includes an analysis of sediment from culvert failure. Sediment at risk due to culvert failure is that saturated by ponded water at the upstream inlet of undersized culverts or from overflow of ponded water onto the road surface with subsequent erosion of the fill. Estimates of the fill volumes in the Lower Blackfoot planning area that are susceptible to culvert failure were made by extrapolation of per crossing means developed from surveyed crossings in the Middle Blackfoot TMDL planning area.

Seventy-three culverts were surveyed in the Middle Blackfoot-Nevada Creek planning area during the 2005 road sediment source assessment. The analysis associated risk of failure with a ratio of culvert width to bankfull channel width (constriction ratio) of less than one. Of the 73 survey sites, 55 had constriction ratios less than one. For the 38 sites in the Blackfoot with constriction ratios less than one, 4,393 tons were estimated as being at risk; a mean value of 115.6 tons per site (RDG, 2006). This mean value was extrapolated to the total of 789 crossings occurring on listed streams in the Lower Blackfoot. The estimated amount of fill at risk in the Lower Blackfoot is 91,208 tons (115.6 tons/site times 789 sites).

Annual loading was estimated assuming a one percent failure rate. Thus, the annual loading estimate equals 912 tons in the Lower Blackfoot. Lacking detailed analysis of failure rates, the one percent failure per year is an estimated point of departure for the purpose of calculating the at risk loads. Adjustments to this failure rate and the resulting loads are warranted when the results of more detailed culvert failure analysis are available for the planning area. Subtotals for watersheds of listed streams are given in **Table F-5**. The annual load is partitioned into controllable versus naturally occurring components by applying a percent reduction derived from an alternative, discharge based culvert failure analysis used in other forested watersheds in Montana.

Table F-5. Annual Loading from Culvert Failure for the Lower Blackfoot Planning Areas

Stream Name	Crossings	At Risk Mass (tons)	Annual Loading (tons/yr)	Controllable Load (tons/year)	Naturally Occurring Load (tons/yr)
Ashby Creek, East Fork	30	3,468	35	27	8
Ashby Creek, West Fork	34	3,930	39	30	9
Belmont Creek	202	23,351	234	180	54
Camas Creek	150	17,340	173	133	40
Elk Creek, Upper	54	6,242	63	49	14
Elk Creek, Lower	71	8,208	82	63	19
Keno Creek	15	1,734	17	13	4
Union Creek	229	26,472	265	204	61
Washoe Creek	4	462	5	4	1
Totals	789	91,208	913	703	210

In these analyses, regression equations developed by the USGS (Omang 1992) were used to estimate peak discharge (Q) for the 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals at surveyed stream crossings based on drainage area (square miles) and mean annual precipitation (inches). Survey data was used to calculate a ratio of ponded headwater depth to culvert inlet depth (Hw:D) at each culvert. Culverts exceeding a Hw:D ratio of 1.4 were considered at risk for failure. The annual probability of modeled discharge, Hw:D ratio and road fill volume subject to erosion at failure were used to quantify annual loading from failure. The existing loading condition assumed that failed culverts were replaced with culverts of the same size. An appropriate reduction from the current loading condition was based on a scenario where failed culverts were upgraded to those passing the Q100 discharge. This scenario follows the guidance from the USFS INFISH recommendations which call for all culverts on USFS land to be able to pass the Q100 flow event. The sediment yields and reductions from the surveyed locations were extrapolated to unsurveyed culverts at the watershed scale. The Q100 replacement scenario resulted in annual loading reductions ranging from 70 to 80 percent. The Q100 replacement BMP and assumed loading reduction were applied to the annual loading estimates to define the controllable and naturally occurring loads. The culvert upgrade scenario was assumed to represent application of all reasonable land, soil, and water conservation practices addressing culvert failure.

The naturally occurring loading is that assumed with the replacement of failed culverts with culverts passing the 100 year discharge (Q100). This long-term strategy for culvert replacement follows the guidance from the U.S. Forest Service, Inland Native Fish Strategy (INFISH) recommendations that call for all culverts on USFS land to be able to pass the Q100 flow event. The Q100 replacement scenario resulted in annual loading reductions ranging from 70 to 80 percent less than loading when failed culverts were replaced with ones of similar size. Of the estimated total of 913 tons annually from failed culverts, 210 tons result with the Q100 replacement scenario. The estimated load reduction with BMP implementation is 703 tons per year.

Allocations for Sediment Loading

The estimated annual load reductions are allocated to land uses within the watersheds of impaired streams. The allocation for each land use is expressed as a percentage of the needed annual reduction for the listed water body and converted to annual reductions in tons per year. The annual reduction allocations given in **Table 8.6** are a composite of those determined separately for hillslope, stream bank and road erosion.

Annual hillslope allocations to land uses are based upon their proportional extent within the stream buffer area assumed as the hillslope source of sediment to stream channels. Values were determined for each stream assessment reach during the 2006 field assessment and verified through interpretation of aerial imagery showing 2005 conditions. The tabulated data for each reach is given in **Table F-6**

Table F-6. Percentage of Land Use Extent within Hillslope Sheetwash Areas of Listed Segments and Corresponding Hillslope Loading Reduction Allocations in the Lower Blackfoot TPA

Segment Name	Livestock Grazing		Irrigated Hay		Silviculture		Rural Residential	
	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)
Ashby East	93	1.30	0	0	4	0.06	3	0.04
Ashby West	68	1.90	0	0	15	0.42	17	0.48
Belmont	85	43.35	1	0	14	7.65	0	0
Keno	0	0	0	0	100	0.10	0	0
Elk Upper	3	0.63	0	0	97	20.37	0	0
Elk Lower	15	0.49	33	1.16	46	1.65	6	0.21
Washoe	8	0.02	14	0.04	45	0.11	33	0.10
Camas	50	7.90	30	4.74	8	1.26	12	2.37
Union	31	14.94	28	13.50	26	12.53	15	7.23

Similar to the hillslope allocations, those for stream bank erosion were allocated according to the percentage of the total stream bank length exhibiting a specific land use as identified during the 2006 field assessment. These percentages are given in **Table F-7**.

The values for land use extent along stream banks do not sum to 100 percent in all cases because clear evidence of discernable land use did not always extend throughout the reach. The land use extent values in **Table F-7** reflect the extent of stream bank over which the corresponding use was judged as contributing sediment. For example, the first row in the table specifies that 10 percent of stream banks in reach Ken1 had a discernable land use that consisted solely of silvicultural practices. The remainder of the reach had no particular land use and contributed minimal sediment loading. Ten percent of the annual loading to Keno1 (0.1 tons/yr) is about 20 pounds per year, not a meaningful allocation considering the project scope and analysis methods. Therefore, there is no sediment reduction allocation in **Table F-7** for Keno1. The remaining three reaches of Keno Creek have reductions allocated to silvicultural practices totaling 0.6 tons per year.

The reduction allocations for roads are the sum of those for road surface erosion and culvert failure. A sediment load reduction of 30 percent was assumed with implementation of construction and maintenance BMPs to reduce loading at crossings. The reduction in culvert failure loading is that assumed with replacement over time with culverts passing the Q100 flow event rather than one of similar diameter as discussed above.

Table F-7. Stream Bank Land Use Extent and Corresponding Stream Bank Erosion Allocations for the Lower Blackfoot TPA.

Stream	Reach	Grazing		Irrigated Hay/Pasture)		Silviculture		Mining		Rural Residential		Total Reach Land Use Extent (%)	Total Reach Reduction Allocation (tons/yr)	Total Segment Reduction Allocation (tons/yr)
		Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)			
Keno	Keno1	0.0%	0.00	0.0%	0.00	10.0%	0.00	0.0%	0.00	0.0%	0.00	10.0%	0.00	0.6
	Keno2	0.0%	0.00	0.0%	0.00	60.0%	0.33	0.0%	0.00	0.0%	0.00	60.0%	0.33	
	Keno3	0.0%	0.00	0.0%	0.00	60.0%	0.10	0.0%	0.00	0.0%	0.00	60.0%	0.10	
	Keno4	0.0%	0.00	0.0%	0.00	70.0%	0.14	0.0%	0.00	0.0%	0.00	70.0%	0.14	
Upper Elk	Elk1	0.0%	0.00	0.0%	0.00	10.0%	0.03	0.0%	0.00	0.0%	0.00	10.0%	0.03	13.4
	Elk2	0.0%	0.00	0.0%	0.00	25.0%	0.21	20.0%	0.16	0.0%	0.00	45.0%	0.37	
	Elk3	0.0%	0.00	0.0%	0.00	30.0%	1.96	20.0%	1.31	0.0%	0.00	50.0%	3.27	
	Elk4	0.0%	0.00	0.0%	0.00	5.0%	0.25	80.0%	4.00	0.0%	0.00	85.0%	4.25	
	Elk5	0.0%	0.00	0.0%	0.00	0.0%	0.00	40.0%	1.36	0.0%	0.00	40.0%	1.36	
	Elk6	0.0%	0.00	1.2%	0.12	0.0%	0.00	40.0%	3.97	0.0%	0.00	41.2%	4.10	
Lower Elk	Elk7	20.0%	10.70	54.6%	29.22	0.0%	0.00	10.0%	5.35	0.0%	0.00	84.6%	45.27	93.7
	Elk8	20.0%	4.13	79.8%	16.48	0.0%	0.00	0.0%	0.00	0.0%	0.00	99.8%	20.61	
	Elk9	40.0%	7.43	59.6%	11.07	0.0%	0.00	0.0%	0.00	0.0%	0.00	99.6%	18.50	
	Elk10	0.0%	0.00	12.9%	2.47	0.0%	0.00	30.0%	5.72	6.0%	1.14	48.9%	9.34	
Belmont	Bel1	0.0%	0.00	0.0%	0.00	85.0%	0.26	0.0%	0.00	0.0%	0.00	85.0%	0.26	13.6
	Bel2	0.0%	0.00	0.0%	0.00	85.0%	3.03	0.0%	0.00	0.0%	0.00	85.0%	3.03	
	Bel3	0.0%	0.00	0.1%	0.01	80.0%	6.26	0.0%	0.00	0.0%	0.00	80.1%	6.26	
	Bel4	0.0%	0.00	20.0%	1.36	40.0%	2.72	0.0%	0.00	0.0%	0.00	60.0%	4.08	
Washoe	Washoe1	0.0%	0.00	0.0%	0.00	50.0%	0.05	10.0%	0.01	0.0%	0.00	60.0%	0.06	10.8
	Washoe2	0.0%	0.00	0.0%	0.00	15.0%	2.99	5.0%	1.00	2.2%	0.43	22.2%	4.42	
	Washoe3	20.0%	1.21	5.0%	0.30	0.0%	0.00	0.0%	0.00	42.5%	2.56	67.5%	4.08	
	Washoe4	20.0%	0.50	46.1%	1.15	0.0%	0.00	0.0%	0.00	22.4%	0.56	88.5%	2.22	

Table F-7. Stream Bank Land Use Extent and Corresponding Stream Bank Erosion Allocations for the Lower Blackfoot TPA.

Stream	Reach	Grazing		Irrigated Hay/Pasture)		Silviculture		Mining		Rural Residential		Total Reach Land Use Extent (%)	Total Reach Reduction Allocation (tons/yr)	Total Segment Reduction Allocation (tons/yr)
		Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)	Percent Land Use Extent	Allocation (tons/yr)			
Ashby East	EAshb1	0.0%	0.00	0.0%	0.00	5.0%	0.00	0.0%	0.00	0.0%	0.00	5.0%	0.00	1.1
	EAshb2	0.0%	0.00	2.2%	0.01	25.0%	0.17	0.0%	0.00	0.0%	0.00	27.2%	0.18	
	EAshb3	10.0%	0.11	0.0%	0.00	57.7%	0.65	10.0%	0.11	6.6%	0.07	84.3%	0.95	
Ashby West	WAshb1	0.0%	0.00	0.0%	0.00	52.7%	0.07	0.0%	0.00	10.0%	0.01	62.7%	0.08	2.6
	WAshb2	0.0%	0.00	0.0%	0.00	45.0%	0.12	0.0%	0.00	8.7%	0.02	53.7%	0.14	
	WAshb3	0.0%	0.00	0.0%	0.00	50.0%	1.62	0.0%	0.00	22.9%	0.74	72.9%	2.36	
Camas	Cam1	0.0%	0.00	0.0%	0.00	34.2%	0.03	0.0%	0.00	0.0%	0.00	34.2%	0.03	87.1
	Cam2	20.0%	9.14	11.9%	5.44	24.0%	10.96	0.0%	0.00	7.5%	3.42	63.4%	28.95	
	Cam3	0.0%	0.00	75.0%	10.10	0.0%	0.00	0.0%	0.00	6.2%	0.83	81.2%	10.93	
	Cam4	0.0%	0.00	70.0%	17.57	0.0%	0.00	0.0%	0.00	27.8%	6.99	97.8%	24.56	
	Cam5	30.0%	1.79	38.5%	2.30	0.0%	0.00	0.0%	0.00	27.0%	1.61	95.4%	5.69	
	Cam6	20.0%	2.49	73.3%	9.12	0.0%	0.00	0.0%	0.00	3.9%	0.49	97.3%	12.10	
	Cam7	0.0%	0.00	99.4%	4.80	0.0%	0.00	0.0%	0.00	0.1%	0.00	99.5%	4.80	
Union	Union1	0.0%	0.00	0.0%	0.00	63.3%	31.93	0.0%	0.00	0.0%	0.00	63.3%	31.93	677.8
	Union2	0.0%	0.00	27.9%	1.88	8.0%	0.54	0.0%	0.00	44.9%	3.03	80.8%	5.44	
	Union3	10.0%	0.54	25.0%	1.36	0.0%	0.00	0.0%	0.00	33.6%	1.83	68.6%	3.73	
	Union4	10.0%	0.17	50.0%	0.84	0.0%	0.00	0.0%	0.00	32.9%	0.55	92.9%	1.55	
	Union5	0.0%	0.00	11.6%	5.68	0.0%	0.00	0.0%	0.00	71.3%	34.91	83.0%	40.60	
	Union6	20.0%	6.03	33.3%	10.06	0.0%	0.00	0.0%	0.00	6.3%	1.89	59.6%	17.99	
	Union7	20.0%	0.79	54.5%	2.17	0.0%	0.00	0.0%	0.00	0.0%	0.00	74.5%	2.96	
	Union8	25.0%	1.29	63.8%	3.28	0.0%	0.00	0.0%	0.00	3.9%	0.20	92.7%	4.77	
	Union9	0.0%	0.00	92.0%	19.16	0.0%	0.00	0.0%	0.00	1.9%	0.40	93.9%	19.56	
	Union10	15.0%	54.75	78.3%	285.81	0.0%	0.00	0.0%	0.00	1.6%	5.90	94.9%	346.46	
	Union11	5.0%	11.17	75.7%	169.11	0.0%	0.00	0.0%	0.00	10.0%	22.35	90.7%	202.63	
	Union12	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	74.0%	0.21	74.0%	0.21	